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PART 5.

TRANSACTIONS
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ENTOMOLOGY



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TRANSACTIONS OF THE SOCIETY FOR BRITISH ENTOMOLOGY

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PART 5.

INSECTS ASSOCIATED WITH CULTIVATED FORMS OF *RUBUS*.

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Station, Kent).

INTRODUCTION.

Of the cultivated species of the genus *Rubus*, the most widely grown in this country are the red raspberry (*R. idaeus* L.), Himalaya and black diamond blackberries (both probably selected from *R. procerus* P.J.M.), and the parsley-leaved or cut-leaved blackberry (*R. laciniatus* Willd.). Due to the ease with which hybrids may be obtained from crosses between raspberries, dewberries and blackberries, a large number of varieties also exist. Some are still in the experimental stage, and a few have proved popular and occupy an important position in the fruit-growing industry, such as loganberry, phenomenal berry and youngberry; others have been tested, but due to defects are not of great economic importance, though they may still be of value to the plant breeder, or be retained in variety collections.

All the more important orders of Insecta are represented in the *Rubus* fauna, yet the number of species causing severe injury is remarkably low. Damage to the more widely cultivated forms is caused annually by the raspberry beetle, *Byturus tomentosus* F., in all districts of England. Other insects are of minor importance compared with the depredations of this beetle. In the Cambridge and Wisbech areas, and locally elsewhere, *Notocelia uddmanniana* L. assumes pest proportions, and in Scotland the raspberry bud moth, *Lampronia rubiella* Bjerk., causes quite as much, if not more, damage to raspberry than any other insect. Minor outbreaks of a less extensive nature are caused by the clay-coloured weevil, *Otiorrhynchus singularis* L., and the chafer beetles.

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Three other diseases, the mosaic virus of raspberry, the 'dwarf' of phenomenal berry and cultivated blackberry, also of virus origin, and the 'red berry' disease of blackberry, may in the near future be found to have a direct relationship to certain members of the insect and allied fauna.

Many years ago Theobald (12) listed some twenty-six species of insects associated with raspberry. Since then the acreage devoted to cultivated Rubi has increased enormously, and consequently the fauna has received more detailed study. To-day the number of species known to breed on one form of *Rubus* or another is about one hundred and forty, a four-fold increase in thirty years. These notes are mainly the result of observations made at East Malling during the past two years. Many of the insects noted have been recorded by previous workers; others, more especially the Lepidoptera, have not previously been found on these host-plants.

Since it is impossible, in dealing with such a large number of species, to give details of each, the reader is referred to more extensive reports whenever available. Though every attempt has been made to make this report as comprehensive as possible, it must not be considered exhaustive. Right up to the time of publication lepidopterous larvae, not normally associated with *Rubus*, have been collected and bred. The fauna of wild blackberry has received attention only in so far as it is related to that on the cultivated varieties, no special study of the bramble insects having been undertaken.

Thysanoptera.

Thrips tabaci Lind.

T. flavus Schrank.

T. adusta Uzel.

Limothrips cerealium Haliday.

The flowers and fruits of all kinds of *Rubus* always contain large numbers of thrips, mostly *T. tabaci* and *T. flavus*. Theobald (15) once noticed serious damage to the blossom of *Rubus laciniatus* due to the feeding activities of these insects. Some flowers failed to open, others developed into malformed or withered fruits.

Hemiptera - Heteroptera.

PENTATOMIDAE.

Sehirus bicolor L.

Pentatoma rufipes L. Shield Bug.

Early in June, 1937, a batch of twenty-eight eggs were found on the underside of a loganberry leaf at East Malling. These agreed in every detail with eggs which had been deposited by *S. bicolor* and which had been described by Masseur (5). The

larvae all died in the third instar, possibly due to a vegetarian diet. Butler (2) suggests this species may be, in part at least, carnivorous.

P. rufipes is not uncommon in both nymphal and adult stages on cherry. Raspberry is sometimes used as a host-plant. Like the preceding, it is probably predacious, though some authors consider the bug to suck plant juices.

CIMICIDAE.

- Anthocoris nemoralis* F.
A. nemorum L. (= *sylvestris* L.).
Triphleps majuscula Reut.
T. minuta L.
Triphleps sp.

A group of predatory and beneficial insects. Adults are present in the spring, nymphs first appear in numbers during July, and adult and immature forms are found until October. These insects, when in search of food, extend the rostrum horizontally and spear their prey, then suck the body juices. Aphides, both immature and adults, and mites are the most frequent victims, with an occasional capsid and jassid nymph to vary the diet. The immature forms are often found on the ripe fruits, but whether they suck the juice or lie in wait for other insects is uncertain.

A. nemorum and *T. majuscula* are by far the most numerous, living on the undersides of the leaves or among the blossom and fruit clusters.

A large species of *Triphleps*, as yet unnamed, has been collected in small numbers from loganberry and blackberry blossoms at East Malling in the last few years. Some specimens were found in the autumn of 1935 sheltering in the corrugated cardboard bands placed around the trunks of apple trees to trap the apple blossom weevil (*Anthonomus pomorum* Curt.). So far only mature females have been taken.

CAPSIDAE.

- Phytocoris tiliae* F.
P. longipennis Flor.
P. ulmi L.
Calocoris norvegicus Gmel.
C. fulvomaculatus De Geer. Shy bug.
Lygus pabulinus L. Common green capsid bug.
L. pratensis L. Bishop bug.
Capsus ruber L.
Aëtorhinus (*Blepharidopterus*) *angulatus* Fall.
Heterotoma meriopterum Scop.

Malacocoris chlorizans Panz.
Psallus salicellus Mey.
Plagiognathus chrysanthemi Wolff.
P. arbustorum F.

L. pabulinus is often a serious pest of soft fruits and, to a less extent, top fruits. In all fruit-growing districts it severely damages much of the cultivated blackberry foliage, first on the lateral shoots of the overwintered cane, later on the new cane. However, it does not confine its attentions to blackberry, for nearly every variety of *Rubus* is attacked to some degree. Raspberry appears to be the least attractive food-plant of the *Rubus* group, and also shows less injury from feeding punctures than most varieties. When feeding, the nymphs and adults inject some toxin into the leaf, which kills the surrounding cells. The first symptoms are brown spots, developing into holes as the leaves grow.

Unlike the other important fruit capsid, *Plesiocoris rugicollis* Fall., this species has two generations each year. Formerly it was considered that the second brood developed from eggs laid in weeds and herbaceous plants. A more detailed study of the life-cycle on *Rubus* in the last few years has provided adequate evidence to show that many of the first generation adults do not migrate, but deposit eggs in the young canes of the original host plants. The adults of this second generation, together with those from the weeds and other plants, lay eggs in the canes, which form the overwintering phase.

Other Capsidae have received a detailed study by Steer (9), who collected nymphs of the following species from *Rubus* and reared them to maturity on raspberry leaves:—

P. tiliae, *P. longipennis* and *P. ulmi* are found frequently on raspberry, loganberry and blackberry as adults; the nymphs are less common.

Nymphs of *C. norvegicus* from the second stage onwards were abundant on raspberry and loganberry; adults appeared in late June and persisted until September.

Only later nymphal stages of *C. fulvomaculatus* have been observed on raspberry. This was adjoining a hop garden, and since this species is a pest of hops the individuals may have migrated to the raspberries.

L. pratensis has a wide range of host plants, reaching pest proportions at times on chrysanthemums and other flowering plants. Nymphs collected from raspberry in late August and September matured about a month later. Butler (2) states that the insects of the year mature by August, thus the presence of nymphs until October suggests a second brood.

C. ruber, *A. angulatus* and *H. meriopterum* are common during June and July as nymphs, the adults appearing in

August. *C. ruber* is a carnivorous species, aphides, jassids and acari serving as food. The other species are also probably partly predacious, and they are also attracted to the fruit.

Adults of *M. chlorizans* have been found in numbers on raspberry from July to September, preying on the mite *Oligonychus ulmi* Koch. Only fourth and fifth stage nymphs are reported from *Rubus*.

A few nymphs of *P. salicellus* in the final instar have been obtained from raspberry late in August. Adults are much more common on raspberry, loganberry and blackberry during August and September.

Both *P. chrysanthemii* and *P. arbustorum* occur on raspberries as nymphs and adults, *arbustorum* being by far the commoner and also plentiful on loganberry and blackberry.

Hemiptera - Homoptera.

CERCOPIDAE.

Philaenus leucophthalmus L.

The nymphs are found fairly commonly on the undersides of raspberry and loganberry leaves during the spring. By May all are mature, and apart from an occasional newly-emerged adult, no more specimens are taken on *Rubus*, which suggests that the adults migrate to other plants.

JASSIDAE.

Empoasca flavescens F.

Typhlocyba debilis Doug.

T. pruni Edw.

T. prunicola Edw.

T. rosae L.

T. tenerrima H.-S.

Erythroneura angustata Leth. var. *moesta* Ferr.

Leaf-hoppers swarm on cultivated blackberries in the spring and the autumn. On the other forms of *Rubus* they are less common. Since the blackberries retain leaves throughout the winter there is an influx of adult jassids in the autumn months, seeking winter shelter. Very few remain throughout the winter.

These species have been identified from adults, collected as nymphs and bred; *E. flavescens* and *T. tenerrima* from cultivated blackberry, the others from raspberry. Although there is a greater number of species, at present, from raspberry, further investigations will doubtless reveal quite as many species on blackberry.

PSYLLIDAE.

Trioza remota Forst.

Although *T. remota* does not breed on *Rubus*, it is of interest to note that many adults have appeared on the undersides of leaves of many varieties during the last three autumns at East Malling. The first specimens are found in early October, and some persist until late December when, with the exception of a few leaves on the cultivated blackberries, all the canes have lost their leaves. Edwards (4) gives oak as the host-plant, and remarks that this species occurs on conifers in winter. It would appear that this influx to *Rubus* coincides with a migration from the oak in search of more sheltered winter quarters. This insect must possess strong flight powers, as the nearest oaks are half a mile from the blackberry plot.

ALEYRODIDAE.

Aleurodes rubi Signoret.

A. rubicola Douglas.

Very little is known about the white-flies on *Rubus*. These two species were recorded from wild blackberry, but adults and immature forms may be found on most cultivated varieties in small numbers every year.

APHIDIDAE.

Macrosiphum gei (Koch.).

M. rubiellum Theo.

M. rubifolium Theo.

Myzus convolvuli (Kalt.).

M. ornatus Laing.

Amphorophora rubi (Kalt.).

Aphis idaei Van der Goot.

Aphis sp.

Pemphigus rubiradicis Theo.

M. gei is a very polyphagous species, only appearing on raspberry and blackberry in October. Viviparous reproduction continues until the raspberry leaves fall in December, and by the end of the year no aphides are left on blackberry. Though occasional colonies are found on the leaves each autumn, no sexual forms have been observed. This species probably feeds on weeds during the summer months, migrating to *Rubus* when these die down.

M. rubiellum prefers blackberries; it will also breed on hybrids with a blackberry parent. Repeated efforts in recent years have failed to establish colonies on raspberry during the

spring months, but in the autumn oviparae will mature on this host. Eggs laid on the canes from November to January hatch in February or early March, and by April the apterae are often so numerous as to cause severe leaf curling on the blackberries. A migration to *Poa annua* L. occurs in late May and early June, the sexuparae returning to *Rubus* again in October.

M. rubifolium is larger than *rubiellum* and has both a green and a red form. The same preference for host-plants of blackberry origin is shown by *rubifolium*. No large colonies are noticed until June, when considerable numbers of both forms congregate around the tips of young blackberry canes, more especially the wild blackberry. By the latter part of July the population has diminished considerably and remains low for the rest of the year.

Myzus convolvuli and *M. ornatus* are more common on plants other than *Rubus*. The former is occasionally taken on raspberry, the latter on cultivated blackberry.

Another species living entirely on *Rubus* is *A. rubi*. Much more catholic in its tastes than the previous species, it has been found breeding on all forms except loganberry and phenomenal berry. Raspberry is probably the most attractive food-plant. Eggs are laid on the basal halves of the canes in the autumn and hatch in March. This species lives only on the undersides of the leaves, and even when the population is high the foliage shows no symptoms of damage.

There are two species of *Aphis* on *Rubus*, both small, and living gregariously at the tips of the shoots or along the stems of the blossoms until June. On raspberry and raspberry hybrids the species is *idaei*, a pale green aphid. Its counterpart on blackberries and blackberry hybrids has yet no specific name, but comes very close to *urticaria* Kalt. Besides being a much darker green, this unnamed aphid has wider and shorter cornicles than *idaei*. Both produce winged forms in June, but continue to live on *Rubus* throughout the summer and do not migrate. After the winged generation *idaei* disperses and lives on the undersides of the leaves, whilst the other species remains gregarious until the autumn. The position chosen for egg-laying is identical — around the base of a petiole or between the axillary bud and the cane.

It is worth mentioning that *A. idaei* is the only species known to breed freely on loganberry and phenomenal berry.

About ten years ago some aphides were found on the roots of raspberries at East Malling. Theobald described them as a new species, *Pemphigus rubiradicis*. Since that date no specimens of this species have been reported.

COCCIDAE.

Lecanium corni Bouché. European fruit scale.

At one time the European fruit scale was very common on all kinds of soft fruits. Since the introduction of tar distillate washes it has disappeared completely from well-sprayed plantations. Nowadays it is only found in neglected orchards and gardens. A few scales were noticed on Lloyd George raspberries at East Malling in 1936, and a loganberry cane was received in an infested condition from Somerset in 1938. Apart from isolated cases like these, *L. corni* has ceased to trouble the fruit-grower.

Neuroptera.

Members of this family have no direct relationship with the host-plant. The larvae are carnivorous, and prey on the aphids and other small insects. The eggs with their long slender stalks (*Chrysopidae*) are deposited on the undersides of the leaves, and the larvae always appear to be actively hunting about in search of food. As with the other predatory insects, it is probably the food supply and not the host-plant which attracts the adult when she is egg-laying.

Lepidoptera.

More species of Lepidoptera are present on cultivated forms of *Rubus* than of any other insect order. Nearly all contained in the following list have been bred from larvae collected in the East Malling district of Kent since 1936. In the majority of species the larvae are found singly, feeding on the foliage, and occur in such small numbers that little or no damage is caused to the plants. Another striking fact is the very small number of species with *Rubus* as their main host. With the exception of *Notocelia uddmanniana* L. and *Lampronia rubiella* Bjerk., all are more common on plants which do not belong to the genus *Rubus*. Those listed without further comment are present each year in small numbers as larvae on the widely grown varieties—raspberry, loganberry, phenomenal berry and the cultivated blackberries.

The following nomenclature has been adopted:—

RHOPALOCERA: 'The Generic Names of British Rhopalocera,' published by the Roy. Ent. Soc. London, 1934.

GEOMETRIDAE: H. J. Turner's 'List of the Geometers of the British Isles' in the *Ent. Rec.*, 1925-6, Vols. 37-8, suppl.

Other 'MACRO-LEPIDOPTERA': R. South's 'Moths of the British Isles,' 1907.

'MICRO-LEPIDOPTERA': E. Meyrick's 'Revised Handbook of British Lepidoptera,' 1927.

RHOPALOCERA.

HESPERIIDAE.

Syrictus malvae L. Grizzled skipper.

This is the only butterfly whose larva is known to feed on forms of *Rubus* other than wild blackberry. Though bramble is recognised by collectors as a host-plant, no larvae have been reported from cultivated forms since 1904 (12).

HETEROCERA.

NOTODONTIDAE.

Phalera bucephala L. Buff-tip.

THYATRIDAE.

Habrosyne derasa L. Buff arches.

Thyatira batis L. Peach-blossom.

LYMANTRIDAE.

Orgyia antiqua L. Vapourer moth.

Dasychira pudibunda L. Pale tussock.

Euproctis chrysorrhoea L. Brown-tail.

Small numbers of larvae of the pretty peach-blossom moth feed on raspberry every year.

H. derasa is well known on wild blackberry, and was tested as a possible agent for the biological control of this plant in New Zealand, but as raspberry and loganberry were also readily accepted as food it had to be rejected.

The remaining species are more common on other fruits, sometimes reaching pest proportions, and occur sparsely on *Rubus*. *P. bucephala* is probably most numerous on nuts, *O. antiqua* will attack all kinds of top fruits, as does *E. chrysorrhoea*. *D. pudibunda* chooses hop as its favourite host plant, and the larva is known as the hop dog; this species has been noticed once, in the pupal stage, on cultivated blackberry.

NOCTUIDAE.

Acronycta psi L. Grey dagger.

A. rumicis L. Knot grass.

Agrotis exclamationis L. Heart and dart.

Mamestra persicariae L. Dot moth.

Phlogophora meticulosa L. Angle shades.

Amphipyra tragopogonis L. Mouse moth.

Taeniocampa gothica L. Hebrew character.

T. stabilis View. Common quaker.

T. incerta Hufn. Clouded drab.

T. gracilis F. Powdered quaker.

Calymnia trapezina L. Dun-bar.

Calocampa exoleta L. Sword grass.

Plusia gamma L. Silver-Y.

Zanclognatha tarsipennalis Treits. Fan-foot.

Apart from certain Tortricids and *Lampronia rubiella* Bjerk., *T. gracilis* is the commonest species of Lepidoptera on *Rubus*. During May and June the larvae live beneath a slight web, either on the upper surface of a young leaf, or at the tip of a new cane. Considerable numbers often occur within a very localised area, the rest of the plantation being free from attack.

A. psi, *A. rumicis*, *M. persicariae* and *T. incerta* are all widely distributed on various kinds of fruit. Each year a few larvae of these species feed on most varieties of *Rubus*.

A. tragopogonis and *T. gothica* are included on the strength of a single larvae of each species taken from cultivated blackberry.

Theobald recorded the larvae of *A. exclamationis* (13) from loganberry, and *C. exoleta* (14) and *Z. tarsipennalis* (12) from raspberry. None of these has been observed on cultivated forms of *Rubus* in recent years.

GEOMETRIDAE.

Operophtera brumata L. Winter moth.

Cidaria truncata Hufn. Common marbled carpet.

C. albicillata L. Beautiful carpet.

Semiothisa notata L. Peacock moth.

Phigalia pедaria Fb. Pale brindled beauty.

Biston betularia L. Pepper and salt moth.

As a pest of apples and other top fruits the larvae of *O. brumata* are of great importance, yet on *Rubus* this species is singularly scarce.

P. pедaria and *B. betularia* are both generally distributed on most kinds of fruits, but raspberry is the only host from the *Rubus* group. Single larvae of each species are found at intervals feeding on the foliage.

C. albicillata was recorded from raspberry by Theobald in 1904 (12).

S. notata has not yet been taken on any cultivated varieties, but the presence of occasional larvae on wild blackberry does indicate that *Rubus* is a host plant.

HEPIALIDAE.

Hepialus humuli. Ghost moth.

H. lupulina. Common swift.

As long ago as 1896, Ormerod (8) noticed the larvae of

H. lupulinus attacking the roots of raspberry plants. Since then the larvae of *H. humuli* have been reported causing similar damage. Hop is a favourite host-plant of both species, and before planting an old hop garden with strawberries or raspberries it is advantageous to make sure there are no larvae of the swift moths in the soil, or serious damage to the roots may result.

PYRAUSTIDAE.

Phlyctaenia prunalis Schiff.

One adult was obtained from a larvae found feeding on loganberry at East Malling in 1936.

TORTRICIDAE.

Batodes angustiorana Haw.

Cacoecia podana Scop.

C. rosana L.

C. lecheana L.

Pandemis heparana Schiff.

P. ribeana Hübn.

Tortrix forsterana F.

T. diversana Hübn.

Cnephasia virgaureana Treitsch.

Peronea asperana Hübn.

P. comariana Zell. Strawberry tortrix.

EUCOSMIDAE.

Spilonota ocellana F. Bud moth.

Notocelia uddmanniana L. Bramble shoot-webber.

Argyroploce variegana Hübn.

A. urticana Hübn.

Among these Tortrix moths the larvae of *N. uddmanniana* are the most destructive. A report on the life-history and habits is now in preparation by the same author. Adults appear in late June and July and lay their eggs singly on the leaves of the new canes. The larvae moult twice before hibernating in August between the base of a petiole and the axillary bud. On emergence in April they feed on the lateral shoots of the old canes or migrate to the young canes, spinning a web which binds the terminal leaves together. From now until the larvae pupate in May they feed on the blossom buds or tips of the young canes, and where numerous, as in the Cambridge and Wisbech areas, cause serious damage to new canes of loganberry and phenomenal berry.

B. angustiorana, *C. podana*, *S. ocellana* and *A. variegana* are more usually associated with apples, where the young larvae feed on the surface of the maturing fruit in August and

September, and later when it is stored. On *Rubus* they all feed on the leaves and cause no appreciable damage.

T. forsterana is sometimes locally numerous on loganberries and blackberries.

Large numbers of the larvae of *P. comariana* were present in a loganberry plantation near Maidstone during May and early June of 1938. The larval habitat was the dorsal surface of a leaf with the halves webbed together. In spite of there being several larvae on each plant in the spring, by July the only evidence was a few malformed leaves and the plants suffered no ill effects. A series of moths bred from larvae on loganberry showed practically the entire range of colour variation obtained by other workers who have collected larvae from strawberry, on which plant this species is sometimes a pest.

The larvae of *A. urticana* prefer blackberry as a food plant. Only one specimen of *T. diversana* was bred, the host plant being loganberry.

GELECHIADAE.

Anacamptis populella Clerck.

HELIODINIDAE.

Schreckensteinia festaliella Hübn.

LAMPRONIADAE.

Lampronia rubiella Bjerck. Raspberry moth.

A. populella is common on the poplars planted as windbreaks along the headlands of many fruit plantations. At times occasional larvae have been found feeding on loganberry.

S. festaliella is another species observed by Theobald (12) on raspberry.

Next to *N. uddmanniana*, *L. rubiella* is the most important species of Lepidoptera on *Rubus*. The moth lays her eggs during May and June in the blossoms, and the young larvae, white at first, later becoming a brilliant red, feed on the fruit until it is almost ripe. They then wander down the cane to hibernate in the old stubs, among debris or in the soil (3). In April they ascend the canes, burrow into a lateral shoot, often reaching as far as the pith, and destroy it. When fully fed the larvae crawl on to a leaf, spin a small web and pupate. If this insect is abundant it is not difficult to realise how greatly the crop may be reduced. Raspberry, loganberry and phenomenal berry are the varieties most usually attacked.

NEPTICULIDAE.

Nepticula aurella Staint.

The larvae occur as leaf miners on cultivated and wild blackberries.

Coleoptera.*

COCCINELLIDAE.

Adalia bipunctata L. Two-spot ladybird.

Coccinella 7-punctata L. Seven-spot ladybird.

The former is by far the more common on *Rubus*. Both species are entirely beneficial, feeding almost exclusively on aphides. Egg batches are common on the undersides of leaves near any aphid colony. The larva or 'nigger' is very partial to the colonies of *Aphis idaei* Van der Goot, on raspberry, and *Macrosiphum rubiellum* Theo. on blackberry, during the spring months before the aphides develop wings and disperse and migrate respectively. From early June until August, when the second generation of ladybirds matures, the larvae have to live a more active life as the aphides are scattered and no longer in colonies.

Adults are also predacious, and may be found from the spring months, when warmer weather entices them from hibernation, until the onset of colder conditions in the autumn.

BYTURIDAE.

Byturus tomentosus F. Raspberry beetle.

This beetle, during its larval stage, is by far the most destructive pest of loganberry, blackberry and raspberry; in fact the fruits of all *Rubus* varieties are attacked. Egg laying, usually in the blossom, commences in June and continues for several weeks. On hatching the young larva burrows into the fruit, eventually reaching the plug, and also feeds on the basal drupelets. When mature it drops to the ground, constructs a small earthen cell in the soil and pupates after an interval of about five weeks. Four to five weeks later the adult may be found. It overwinters in the underground cell, not emerging until the following April or May.

Besides damage to the fruits, caused by the larvae, adults destroy the blossom buds before they fully open, and also skeletonise the leaves at the tips of the young canes. This insect can be effectively controlled by derris (10).

SCARABAEIDAE.

Melolontha vulgaris F. Cockchafer.

Phyllopertha horticola L. Garden chafer.

Amphimallus solstitialis L. Summer chafer.

Cetonia aurata L. Rose chafer.

Adults and larvae of all four species are sometimes injurious, more so to the raspberry than other *Rubus* varieties. The

*The nomenclature of the Coleoptera follows Sir Thomas Hudson Beare's 'Catalogue of the Recorded Coleoptera of the British Isles,' London, 1930.

larvae of *M. vulgaris* and *C. aurata* cause greatest damage, by feeding on the roots, thus reducing the vigour of the canes, and in extreme cases causing death.

Adults of all four species are found feeding on the foliage, but what is of greatest importance to the fruit-grower is the damage to the blossom buds. *M. vulgaris* and *C. aurata* are on the wing from May until early July, *P. horticola* and *A. solstitialis* appear somewhat later, and are present until the end of July.

Normally the outbreaks are of a localised nature. The most common habitat of the chafer grubs is grassland. When land, previously down to grass, is ploughed up and planted with fruit, any chafer larvae present are deprived of their original food and adapt themselves to the new crop. Unless measures are taken to destroy the grubs before planting this is a common cause of outbreaks, especially to soft fruits—strawberries and raspberries—and young apples may even be attacked.

CHRYSOMELIDAE.

Batophila rubi Pk.

B. aerata Mm.

Very little is known about the life-histories of these flea beetles. Adults feed on the upper surfaces of the leaves of blackberry, loganberry and phenomenal berry during the late spring. On bright, sunny days the beetle is very active; when the weather is dull it may be captured with ease. *B. rubi* is generally recognised as the commoner species, yet all the specimens taken at East Malling in recent years have been *B. aerata*.

CURCULIONIDAE.

Rhynchites germanicus Herbst. (= *minutus* Thom.).

R. aeneovirens Marsh. [according to some authorities this species is now *R. minutus* Herbst., and *aeneovirens* is a synonym.]

Both these weevils were first noticed many years ago causing damage to strawberry. *R. germanicus* has occurred regularly in Kent during the past few years, in small numbers on raspberry, loganberry, phenomenal berry and cultivated and wild blackberry. The adult first appears in April and is often found as late as August. Eggs are laid in small holes excavated in the current year's cane, near the growing point, or occasionally in a petiole. Immediately after egg laying the weevil girdles the shoot below the egg cavity with a ring of punctures, which produces wilting and death of the growing tip. This damage prevents the formation of one strong cane, and leads to the growth of several weaker lateral branches.

R. germanicus has never been found in sufficient numbers on commercial plantations of *Rubus* to cause serious injury. During 1937, however, a raspberry seedling bred at East Malling was so badly attacked that the following year's crop records were of little value as experimental records.

R. aeneovirens is more usually found on strawberry and has been recorded from *Rubus* on only one occasion (11). When strawberries are attacked, the weevils girdle the petioles of the leaves and the stalks of the flower trusses.

Otiorrhynchus clavipes Bf. Red-legged weevil.

O. singularis L. Clay-coloured weevil.

O. sulcatus F. Vine weevil.

O. singularis is the most common of these wingless weevils, and was at one time called the raspberry weevil (12). *O. clavipes* is more common in districts where the soil is chalky, and tends to replace the former species in these areas. *O. sulcatus* is the weevil which causes so much damage to vines, but is found less frequently on other fruit.

The habits of all three weevils are very similar, and practically every kind of fruit is attacked. It is during the spring months that most serious injury is caused, and raspberry appears to be a favourite host. During the day, the adults hide beneath clods of earth and other debris at the base of the canes. Feeding mainly by night they attack the foliage and blossom buds, either completely severing the stalks, or biting sufficient to produce wilting and subsequent death of the damaged parts. They also gnaw the rind of young canes, sometimes injuring them so badly that the growing point is killed. *O. singularis* has been observed feeding on the rind of the roots and this considerably reduces the vigour of the plant. In raspberry plantations where the first two species are very numerous, large numbers of canes may be completely defoliated. The larvae feed on the roots of plants, especially strawberry and raspberry, but cause less damage than the adults.

Phyllobius oblongus L.

P. pyri L.

P. maculicornis Gm.

These leaf-eating weevils are present in varying numbers on most fruit trees every spring. It is only when they are exceptionally numerous that sufficient leaf area is devoured to affect the growth of the canes.

Anthonomus rubi Herbst. Strawberry blossom weevil.

Also called the elephant beetle from its long snout or rostrum, this weevil is primarily a pest of strawberries. Only in the Hampshire strawberry-growing districts is it ranked as a common pest.

The adult appears in April or May and lays its eggs in the unopened blossom buds, then partially or completely severs the bud stalk. In normal seasons only a negligible percentage of raspberry and blackberry blossoms are attacked in this country. At its worst the outbreak is confined to a single plantation or district. On the Continent the weevil sometimes destroys the tips of young raspberry canes.

IPIDAE.

Xyleborus dispar F. Shot hole borer.

Though commonly found boring in plum and other fruit trees, cultivated blackberry is an unusual host for this beetle. During May, 1937, blackberry shoots were received from Sussex containing holes and adult females. All the plants attacked died before blossoming, and it was impossible to decide whether the beetles caused this loss, or whether unhealthy plants attracted the beetles. No healthy blackberries were observed with shot holes, which does support the suggestion that the condition of the plants was the primary cause of the attack.

Hymenoptera.

TENTHREDINIDAE.

Cladius difformis Panz.

Emphytus rufocinctus Retz.

Empria tridens Kon.

Entodecta pumila Klug.

Priophorus pallipes Lep. Plum leaf sawfly.

P. tener Ladd.

With the exception of isolated outbreaks of *P. pallipes* and *P. tener* in a greenhouse where raspberry seedlings were being raised, the writer has found none of the sawflies in numbers. These two species occur sparingly on raspberries, loganberries and phenomenal berries in Kent every year. The larvae of *P. pallipes* are sometimes noticed feeding on the foliage of plum trees (6).

In the north of England *E. tridens* is the most common and destructive species on raspberry (7).

Several larvae of *E. pumila* were found mining the leaves of cultivated blackberry, and to a lesser extent raspberry, at East Malling in the autumn of 1938. This is the first time for many years that the species has been observed in the district. Theobald (13) mentions *Fenusa pumila* Klug. as a leaf-mining species on raspberry and blackberry. As far as is known *F. pumila* is associated with birch and not *Rubus*.

Another sawfly often quoted as a pest of raspberry is the rose *Emphytus*, *Emphytus cinctus* L. There are no authentic records of late years, and it is possible that larvae found overwintering in the snags have sometimes been wrongly identified.

ICHNEUMONIDAE.

Omorgus mutabilis H. Gr.

BRACONIDAE.

Apanteles sp.

Aphidius sp.

These are parasites of other members of the fauna.

O. mutabilis parasitises the larva of *Notocelia uddmanniana* L., and appears to be very effective in the East Malling district. During the past three years, from several hundred Tortricid larvae collected, the percentage parasitised has varied from 36-50 per cent. Unfortunately the parasite does not kill the larva until it has reached the fourth or fifth instar, by which time the host plant has already been considerably damaged. Occasionally *N. uddmanniana* pupates before the parasite appears.

A few specimens of an undescribed species of *Apanteles* were also bred from the larvae of *N. uddmanniana*.

The only species of Aphididae parasitised to any extent is the unnamed species, closely allied to *Aphis urticaria* Kalt. A species of *Aphidius* is often responsible for destroying large proportions of these aphidid colonies.

Diptera.

TIPULIDAE.

Tipula oleracea L.

Tipula paludosa Meig.

Sometimes the roots of newly planted raspberries and loganberries are severely damaged by crane-fly larvae or leather-jackets. Often the reason is obvious; an old pasture or hop garden, previously infested, has been planted without any attempt to eradicate these pests. Strawberry runners planted under similar conditions suffer still greater injury.

CECIDOMYIDAE.

Contarinia rubicola Rüb. Blackberry flower midge.

Dasyneura plicatrix (H. Loew.). Blackberry leaf midge.

Lasioptera rubi Heeg. Raspberry and blackberry stem gall midge.

Thomasiniana theobaldi Barnes. Raspberry cane midge.

A complete description of the Cecidomyiidae is given by Barnes (1).

The adult midges of *C. rubicola* lay their eggs inside the blossom buds of both wild and cultivated blackberries. When mature the larvae 'jump' from the flowers to the soil where pupation takes place. Often the infested buds do not open, or at the best produce malformed fruits.

D. plicatrix is commonest on wild blackberry, where eggs are laid on the leaves during late May and June. Injury by the small, white larvae causes the leaves to fold along the swollen mid-veins and assume very distorted shapes. Pupation occurs in the soil and a second brood appears in July and August.

L. rubi is the midge which causes the familiar walnut-shaped galls on the canes of wild and cultivated blackberry and raspberry. Galls have little effect on the vigour of the canes unless very numerous, then the leaf area is reduced and consequently a smaller crop is gathered. Adult midges deposit 8-15 eggs at the base of a bud on a young cane in May or June. On hatching the larvae burrow through the epidermis, and the plant reacts by forming the gall. Winter is passed in the larval stage and pupation takes place in the gall in the following spring.

One of the lesser known midges, *T. theobaldi*, has been observed on only three varieties of raspberry, Bath's Perfection, Reader's Perfection and Lloyd George. The reddish larvae live under the rind of the cane, sometimes damaging only a localised area, at other times causing the rind to peel off and the consequent death of the shoot tip. Another symptom is excessive branching of the cane. The first flight of midges occurs in late May or June, with probably a second brood in July and August.

ANTHOMYIIDAE.

Phorbia rubivora Coq. Loganberry cane maggot.

Occasional outbreaks of this insect have been reported in this country, always within very restricted areas, and by timely eradication of the infested canes no serious damage has resulted. Adults appear in April and oviposit in the axil of a terminal leaf. On hatching the larvae tunnel downwards in the pith for a few inches, then girdle the cane beneath the epidermis, causing the tip to wilt and die. Having completed this operation they continue burrowing downwards and eventually hibernate as pupae near the base of the cane. Raspberries, loganberries and blackberries are attacked.

DROSOPHILIDÆ.

Scaptomyza graminis Fln.

On one occasion only the larvae of this species have been found feeding on the basal drupelets of raspberry fruits. There is evidence to suggest that the raspberry beetle caused the primary damage and the Drosophilid larvae were of secondary occurrence. *S. graminis* is normally a leaf miner.

SYRPHIDÆ.

The small, ovoid, whitish eggs of several species of this family are found in abundance on all varieties of *Rubus* throughout the late spring, summer and early autumn months. Like the Coccinellids, Syrphid larvae are predacious and entirely beneficial. The legless larvae, usually of a pink or greenish colour, live among the aphidid colonies until June when the aphides produce winged forms and disperse. For the rest of the summer the Syrphid larvae live entirely on the undersides of the leaves, preying on various kinds of small insects and the aphides. As predatory insects, there is no direct affinity to any particular form of *Rubus*. The choice of host-plant is no doubt governed by the potential larval food supply when the eggs are deposited.

TACHINIDÆ.

Nemorilla notabilis Mg.

One specimen was bred from the pupa of *Notocelia uddmanniana* L. No doubt this parasite was present in the larva when collected, but it did not appear until after the Tortricid had pupated.

Acarina.

ERIOPHYIDÆ.

- Eriophyes essigi* Hassan. Blackberry mite.
E. gracilis Nal. Raspberry leaf and bud mite.
E. rubicolens Can.
E. gibbosus Nal.
E. rubi Whitehead.
E. silvicola Can.

In the western states of America, *E. essigi* is the most important mite on blackberries. As a result of the damage caused to the developing fruits by the mites feeding, some of the drupelets fail to ripen evenly, and give rise to the 'red berry' disease. The mite occurs in this country, but it is only found in small numbers on blackberry and loganberry, never reaching the huge populations per fruit that occur in America.

A form of 'red berry' disease is also present in English blackberry plantations, though no association with the mite has yet been traced.

Mites remain on those fruits left on the bushes until decay sets in, then migrate to the buds, where they live beneath the scales until the following spring. Infestation of the fruit begins immediately after the blossom period and reaches a peak in September.

In England *E. gracilis* is the most common species of mite on all kinds of *Rubus*. The orange colour of this mite readily distinguishes it from *E. essigi*, which is white. Passing the winter under the bud scales, *E. gracilis* reappears in April and migrates to the undersides of the young leaves. When the blossoms open some mites enter the flowers and are found later between the drupelets of the ripe fruits. Those on the leaves live among the leaf hairs and sometimes become so numerous that irritation from their feeding causes dense masses of hairs and a mottling of the upper leaf surface.

E. gibbosus produces hairy patches on the leaves and petioles of cultivated blackberries and many other varieties of *Rubus*.

The other species are not well known in this country. *E. rubicolens* causes a hairy protrusion on the under surfaces of raspberry and dewberry leaves, and *E. silvicola* is responsible for small ovoid, leaf galls. Both have been found only a few times. As regards *E. rubi*, some authorities consider it to be the same as *E. gracilis*; there is only one record from raspberry.

TROMBIDIIDAE.

Allothrombium fuliginosum Herm. Red velvet mite.

Unlike the majority of acari the red velvet mite is not harmful. This animal spends all its time hunting aphides and other mites for food.

TETRANYCHIDAE.

Tetranychus telarius L. Red spider mite.

Oligonychus ulmi Koch. Fruit tree red spider.

T. telarius is nearly always present on raspberry, sometimes in small numbers on the other forms of *Rubus*. During the summer months all stages of the life-cycle may be found on the undersides of the leaves. The red, overwintering females hibernate in the shelter afforded between the buds and the cane, beneath the epidermis where the cane is damaged, or in the soil. In this country the mite rarely causes serious damage to the leaves, yet in Germany severe loss of raspberry foliage is not infrequent.

O. ulmi is better known as a pest of top fruits, especially apple and plum. Its presence on raspberry in large numbers is usually accidental. A severe attack on plum in Norfolk during the summer of 1934 caused defoliation of the trees by August. Raspberries growing beneath the plums became infested and later in the autumn thousands of eggs were visible on the canes. At East Malling in 1937 plum trees along the headland of a raspberry plantation were badly attacked by *O. ulmi*; later in the year eggs of this mite were found on nearly all the raspberry canes, and had been deposited around the base of a petiole or between a bud and the cane. Such a general distribution can only be attributed to dispersal by wind, especially as no red spiders have since been observed.

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SUMMARY.

Brief notes are given for the 132 spp. of insects observed to breed on, or to be associated with, cultivated forms of *Rubus*. Those of economic importance are described in more detail.

Nine spp. of acari are also mentioned.

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